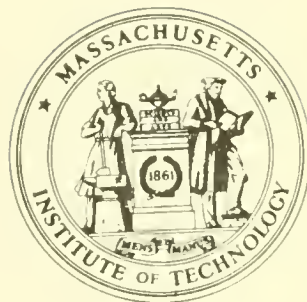




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COLLEAGUE ROLES AND INNOVATION IN SCIENTIFIC TEAMS

Franklin
George F. Farris

M. I. T. Working Paper No. 552-71

July, 1971

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Abstract

The innovation of teams of scientists was related to their colleague role nets, utilizing a model of executive decision making proposed by Farris (1971). Team innovation tended to be associated with greater performance of technical roles within the team, and the supervisor's being more oriented toward his team and less to outsiders. During the idea suggestion stage, the roles most associated with team innovation were the supervisor's receiving original ideas from more outside sources but having fewer original ideas himself, group members providing each other with technical information, and the availability of organizational information from fewer sources inside or outside the group. During the proposal development stage, high innovation teams tended to be characterized by greater exchange of help among themselves in thinking through technical problems and greater usefulness of their supervisors in critically evaluating their ideas. These trends are very consistent with Maier's (1967) theory of group problem solving.

COLLEAGUE ROLES AND INNOVATION IN SCIENTIFIC TEAMS¹

George F. Farris

Massachusetts Institute of Technology

In most scientific laboratories, research and development work is carried out by teams of scientists and engineers. Within a given organization some teams are often cited consistently as being more innovative than others in their R & D work. What factors distinguish these more innovative from less innovative R & D teams?

Previous research has considered factors such as diversity of team members (Pelz, 1957; Pelz & Andrews, 1966), group age (Shepard, 1956; Wells & Pelz, 1966) and characteristics of the supervisor (Andrews & Farris, 1967). Although research on small group problem solving (for reviews, see Cartwright & Zander, 1968; Hoffman, 1965; and Collins & Guetzkow, 1964) suggests that characteristics of the interaction among team members are important determinants of group performance, little research has been devoted to the problem-solving process of scientific teams.

Recently, Farris (1971) proposed that the interaction among members of an organization in making decisions can be conceptualized in terms of the roles they perform for one another in this process. His model considers three stages in the problem-solving process: suggestion, proposal, and solution. (See Figure 1.) Different "colleague roles" -- activities performed by one scientist which facilitate the problem solving of another -- are hypothesized to be important during each stage. Providing original ideas, technical information, and administrative information are said to be important colleague roles which help a scientist to come up with a suggestion. Help in thinking through a problem and critical evaluation are important in shaping the suggestion into a proposal. And, assuring a fair hearing and providing administrative help are colleague roles which can

help in turning a proposal into a solution which is implemented in the organization. Research to date (Farris, 1971; Swain, 1971) has focused on individuals who perform these roles, examining their personal characteristics, working environments, and career development. The present research extends this conceptual approach to the group level.

A central concern in much of the literature on group problem solving has been the relative importance of the formal leader and group members in performing various roles important for innovation. One school of thought (e. g., Maier, 1967) has emphasized the importance of roles performed by the leader of a problem-solving group. Another, often considering "leaderless" groups, has emphasized roles which can be performed by any group member (e. g., Bales, 1950; Benne & Sheats, 1948). Bowers and Seashore (1966) discuss both "supervisory leadership" and "peer leadership." If, following French (1956), leadership is considered to be the ability of one person to influence the behavior of another, then three parties may exert leadership in the problem solving of scientific teams: the supervisor, the team members, and people from outside the group. The relative importance of each is subject to empirical investigation.

In the present study the innovation of scientific teams will be related to the performance of colleague roles for group members by three parties: the supervisor, other group members, and scientists from outside the group. Then the roles performed by the supervisor will be examined in more detail, relating the innovation of his team to his orientation inside and outside his group. Finally, the problem-solving processes of more and less innovative groups will be compared by examining the performance of each colleague role at each stage. As shown in Figure 2, group innovation

will be related to seven colleague roles performed by:

1. The supervisor for his group.
2. Group members for other members.
3. Outsiders for group members.
4. The supervisor for outsiders.
5. Outsiders for the supervisor.
6. Group members for the supervisor.

METHOD

The study was conducted in a division of a NASA research center engaged in a wide variety of R & D activities related to aerospace. Their tasks ranged from basic research on physical and chemical processes to the conduct of atmospheric and deep space experiments using rockets and satellites. One hundred and one professionals participated in this study, eighty-seven bench scientists and fourteen first-line supervisors. The mean group size was 6.2 members, excluding the supervisor, and half the groups contained fewer than five members. Groups ranged in size from two to seventeen members.

As part of an extensive questionnaire describing aspects of their working environment and motivation, the participants in the study were asked to name individuals they saw as being useful to them for seven colleague roles:

Considering the technical activities you have been involved in over the past few years, which people have been most useful to you for the following: (The same person may be named as many times as seems appropriate).

- A. Locating relevant technical information you did not know about previously. (Spaces for up to eight names were provided in each part).
- B. Helping your thinking about technical problems -- e. g., picking out fruitful problems, clarifying the nature of a problem, changing the direction of your thinking about a problem.
- C. Critical evaluation of your ideas.
- D. His own original ideas.
- E. Making sure your ideas get a fair hearing or preventing competing ideas from winning out prematurely.
- F. Providing administrative help in getting you needed resources and facilities.
- G. People from whom you learn about technical administrative developments happening in (name of division.)

For each role, six scores were determined for each group:

- 1. The per cent of group members who mentioned their supervisor.
- 2. The per cent of possible choices of group members by other group members. The number of possible choices was $N(N-1)$, where N = the number of bench scientists in a group.
- 3. The average number of scientists outside the group mentioned by a group member.
- 4. The number of times the supervisor was mentioned by outsiders.
- 5. The number of outsiders mentioned by the supervisor.
- 6. The per cent of group members who were mentioned by their supervisor.

The innovation of each group member was rated by judges who claimed to be familiar with the scientist's work. Innovation was defined for the judges as the extent the scientist's work had "increased knowledge in his field through lines of research or development which were useful and new". Judges were supervisors or senior-level non-supervisors. An average of 7.6 judges, working independently, used a modified rank-ordering procedure to rate the innovation of each scientist's work. Since the judges showed reasonably good agreement (Spearman-Brown estimate for reliability of a multiple item scale = .87), their evaluations were combined into a single percentile score for each scientist. These percentile scores were then adjusted to remove effects attributable to two background factors: time at R & D center, and degree (B. S., M. S., or Ph. D.). Group innovation scores were then calculated by determining the mean adjusted innovation score of the group members (excluding the supervisor). Details on these types of procedures for collecting, combining, and adjusting measures of scientific performance are more fully described in Pelz and Andrews (1966).

RESULTS

The groups were divided at the median innovation score into high and low-innovation categories. The scores on the seven colleague roles were then examined to determine 1) whom the group members find helpful for performing colleague roles, 2) the supervisor's orientation toward his group and outsiders in the performance of colleague roles, and 3) for each colleague role, at each stage in the problem-solving process, the differences which occur between the more and less innovative groups.²

Roles performed for group members

Figures 3-5 show the extent to which members of high and low innovation groups have found three parties to be helpful in their technical work:

their supervisor, other group members, and people outside the group.

Insert Figure 3 about here

Figure 3 shows the per cent of group members who mention their supervisor for colleague roles. On the average, slightly more than fifty per cent of them mention their supervisor. This figure ranges from a high of over 60% for helping thinking and critical evaluation to a low of less than 40% for original ideas. Supervisors are mentioned quite frequently for both technical and administrative roles.

In general the high innovation groups mention their supervisor more than the low innovation groups. Differences are most pronounced for critical evaluation and slightly smaller for helping thinking and administrative help. There appears to be a tendency for the low innovation groups to mention their supervisor more often as being useful for his original ideas.

Figure 4 shows the choices of group members by other group members for the seven colleague roles. Insert Figure 4 about here Overall, group members choose one another quite often, but because there is also a high number of possible choices, the percentages shown in Figure 4 are quite low. They range from 1% to 14%, with an average a little over 6%. Group members tend to find one another useful chiefly for technical roles and least for administrative help and making sure their ideas receive a fair hearing.

Members of the high innovation groups tend to choose one another more often for two technical roles: locating technical information and helping their thinking; members of low innovation groups tend to find one another as more useful for administrative roles, especially providing news of developments in the R & D division.

Figure 5 shows the number of scientists outside the group who are men-

Insert Figure 5 about here

tioned by group members for the seven colleague roles. Overall, they mention about one outsider per man. Outsiders are seen as most useful for providing technical information and helping thinking and least useful for assuring a fair hearing for group members' ideas.

Although the differences are small, there is a consistent trend for the low innovation groups to mention more outsiders as helpful to them in their technical problem solving. Outsiders are especially more useful to the low innovation groups for helping their thinking and assuring a fair hearing for their ideas.

To summarize these trends, it appears that all three parties -- the supervisor, other team members, and outsiders -- perform colleague roles for these scientific teams. Team members are named most often, but the supervisor receives a higher percentage of possible choices. The supervisor and outsiders provide both technical and administrative help, while group members are helpful chiefly in technical areas. The high innovation groups appear to solve problems more as teams. Members find one another more useful for technical roles but less for administrative roles; outsiders are mentioned less often as helpful; and their supervisor is more helpful to them. This finding indicates that the supervisor may be very much a member of the high innovative groups as they engage in technical problem solving. Let us examine the supervisor's roles in more detail.

Supervisor's inside-outside orientation

Figure 6 shows the average number of times the supervisors were mentioned for the colleague roles by scientists outside their group. Across all roles, supervisors are mentioned by an average of a little over one outside person. Outsiders mentioned the supervisors most often for locating technical information and least often for providing a fair hearing or administrative help.

Insert Figure 6 about here

Overall, supervisors of low innovation groups tend to be mentioned more often by outsiders than supervisors of high innovation groups. The strongest differences in this direction occur for the technical roles, especially helping thinking and providing original ideas. For two administrative roles -- providing a fair hearing for ideas and administrative help -- the trend is reversed.

Figure 7 shows the average number of outsiders mentioned by the

Insert Figure 7 about here

supervisors for the various colleague roles. Across all roles, supervisors mention slightly under three outsiders per role. Outsiders are mentioned most often by supervisors as helpful to them for providing technical information and least often as useful for original ideas.

Supervisors of low innovation groups mention more outsiders as useful to them for five of the seven roles. Outsiders are especially more useful to supervisors of low innovation groups for helping their thinking about technical problems and providing news of developments in the division. Supervisors of high innovation groups tend to mention more outsiders as useful to them for their original ideas.

Finally, Figure 8 shows the per cent of team members who are mentioned

Insert Figure 8 about here

by their supervisor as helpful to them in their technical problem solving. Virtually no team members are mentioned by their supervisor as helpful for administrative roles. For the four technical roles, an average of about one

in five team members is mentioned by his supervisor. Team members are especially useful to their supervisor for helping their thinking and original ideas; they are least helpful for providing critical evaluation.

The differences between the high and low innovation groups are striking. Supervisors of high innovation groups mention more team members as helpful to them for all technical roles: locating technical information, helping their thinking about technical problems, critical evaluation, and original ideas.

In summary, these trends indicate that the supervisors of the high innovation groups are a more integral part of their teams' technical problem solving and less oriented toward the outside for technical roles. They find their team more useful to them for their own technical problem solving, and, as shown in Figure 3 above, their teams mention them more often as helpful. Moreover, they are mentioned less often by outsiders for technical roles, and they mention fewer outsiders for technical roles (except original ideas). For the more organizationally oriented roles, the trends are mixed. Let us explore the trends for each role in greater detail.

Roles in the decision-making process

Recall that Farris' (1971) model of executive decision making considered the process in three stages: suggestion, proposal, and solution (See Figure 1). Different colleague roles were said to be more important for each stage: original ideas, technical information, and administrative information for coming up with a suggestion; help in thinking and critical evaluation in shaping the suggestion into a proposal; and a fair hearing and administrative help in the executive decision to make the proposal

an actual solution. How does this process differ in the high and low innovation groups?

Table 1 recasts the data on colleague roles according to the stage of

Insert Table 1 about here

the decision making process. Let us examine each stage separately.

Suggestion stage. Supervisors of the high innovation groups name more colleagues -- both team members and outsiders -- as helpful to them for providing original ideas. On the other hand, they tend to be named less often by others -- both outsiders and group members -- as helpful for their own original ideas. No differences were found in the original ideas colleague role as performed by other group members or outsiders.

Supervisors of the high innovation groups tend to name more group members and fewer outsiders as useful to them for locating technical information. They are named slightly less often by outsiders for this role. There is a tendency for members of the high innovation groups to name one another more often as useful for providing technical information, but no differences occur in the extent to which they name their supervisor or outsiders.

Both the supervisor and the members of the high innovation groups name fewer colleagues -- group members, outsiders, or the supervisor -- as useful to them for providing news of technical and administrative events in the organization.

To summarize, in the suggestion stage it appears that the supervisors of the high innovation teams bring to their team original ideas from more sources (other scientists' ideas, not their own) and technical and organizational information from fewer sources. Group members furnish one another with more technical information and less organizational infor-

mation. Thus, in the suggestion stage, the high innovation teams appear to have available original ideas from more sources inside and outside the group but not from the supervisor himself, more technical information generated within the group, and organizational information from fewer sources of any kind.

Proposal stage. Supervisors of the high innovation teams name fewer outsiders and more group members as useful to them for helping their thinking about technical problems. Similarly, they are named less often by outsiders and more often by their group for this role. Also there are tendencies for group members to receive more help from one another and less from outsiders.

A similar pattern occurs for critical evaluation. Supervisors of the high innovation teams name their group more and outsiders less as helpful in this role. These supervisors in turn are named much more often by their groups and less often by outsiders as helpful for critical evaluation. No difference occurs in the performance of the critical evaluation role for the group by either other group members or outsiders.

In summary, all members of the high innovation teams, including the supervisor, are apt to help one another with their thinking about technical problems. For giving and receiving critical evaluation, the supervisor is similarly more oriented toward his own group than outsiders. Moreover, the extent to which the supervisor provides critical evaluation for his group is a key factor in distinguishing the high and low innovation teams.

Solution stage. The differences between the high innovation and the low innovation teams are smaller at this stage of ^{the} problem-solving process. Both the team and outsiders tend to name the supervisors of the high innovation teams more often for providing administrative help. Very small differences in the same direction occur for the role, "providing a fair hearing

for your ideas." Supervisors of the high innovation teams tend to name outsiders less often for a fair hearing and more often for administrative help.

DISCUSSION

The findings of this exploratory study indicate that the problem solving of scientific teams is facilitated by their supervisors, fellow team members, and scientists from outside the teams. Fellow team members are named most often as helpful, while supervisors receive the greatest percentage of possible choices. Group members are especially helpful in performing technical roles; supervisors and outsiders are helpful in both technical and administrative areas.

A comparison of the relatively high and low innovation groups in this laboratory indicated that the high innovation groups tend to work more as a technical team. Members name each other more often as helpful for performing technical roles. Detailed examination of the supervisor's role nets indicated that he is very much a part of that team. The supervisors of the high innovation groups were named more often by their teams for performing technical and administrative roles; they were named less often by outsiders as helpful for most roles; and, in turn, they received more technical help from their teams.

As the technical decision-making process evolves, it appears more apt to result in innovative work if certain colleague roles are performed by certain parties, especially at the early stages. During the idea suggestion stage, the roles most associated with team innovation are the supervisor's receiving original ideas from more outside sources but having fewer original

ideas himself, group members providing each other with technical information, and the availability of organizational information from fewer sources inside or outside the group. During the proposal development stage, the high innovation teams~~s~~ are characterized by greater exchange of help among themselves in thinking through technical problems and greater usefulness of their supervisors in critically evaluating their ideas.

Like most field research in organizations, this exploratory study suffers from the common problems of small sample size, failing to sample from a finite population, and inability to determine causality. Thus, these findings, although they are based on consistent trends, should be regarded as tentative. To the extent that they accurately describe colleague interaction in the problem-solving process of these scientific teams, however, they have some intriguing implications for theories of problem solving and leadership as well as some practical applications. Let us turn to these now.

Theoretical implications

Three types of theories of group problem solving were mentioned earlier in this paper: those which emphasize the role of the leader (e. g., Maier, 1967), those stressing peer leadership in roles performed by group members for one another (e. g., Benne & Sheats, 1948; Bales, 1950; and Bowers & Seashore, 1966), and those which emphasize the group in its organizational context. The tentative findings of this study have implications for each type of theory.

Maier (1967) suggests that a group is most apt to succeed in its problem-solving efforts when its leader performs an integrative function analagous to that of the nerve ring of the starfish. He does not dominate

the discussion and produce the solution, but instead serves as an integrator by receiving information, facilitating communication among group members, relaying messages, and integrating ideas so that a single unified solution can occur. Moreover, "the idea-getting process should be separated from the idea-evaluation process because the latter inhibits the former." (Maier, 1963, p. 247.)

Supervisors of the high innovation groups in this study were seen as behaving very much in the way Maier says they should. They were named more often by their groups as useful for facilitating thinking and providing critical evaluation, two roles which can be considered integrative functions. Moreover, they received original ideas from more sources outside the group, probably relaying them to group members as appropriate. Equally important, the supervisors of the high innovation groups were seen as less useful for their own original ideas. Thus, they were probably less apt to impose their own ideas on their group, an activity which Maier argues strongly will inhibit group innovation. Probably this situation also represents a considerable degree of separation of evaluation from the production of ideas. The supervisors of the high innovation teams were more useful for critical evaluation, but the ideas they evaluated tended to come more often from other sources -- outsiders (see Figure 7) or team members (see Figure 8).

Theories of group problem solving which emphasize roles performed by group members also received some support. The high innovation teams found other members of their groups to be more useful for providing technical information and helping their thinking, and outsiders tended to be less useful for several roles. Apparently, peer leadership occurred more often in the high innovation groups with respect to these roles, and the high

innovation groups may have been more cohesive in that they found outsiders generally to be less helpful. Against a "peer leadership" theory of group problem solving, however, is the failure of differences to occur between the high and low innovation groups in two other technical roles: critical evaluation and original ideas. Perhaps peer leadership is more important for group innovation only when it is exercised in particular areas. It should be added that the positive findings regarding peer leadership do not deny Maier's emphasis on the role of the leader. His acting in ways Maier says he should would be expected to create a situation where group members are better able to facilitate each other's problem solving.

Theories which emphasize the organizational context of the group receive the least support from the tentative findings. Having more sources of information about technical and administrative developments in the organization was related negatively to group innovation. This held whether the sources were the supervisor, other group members, outsiders, or outsiders talking to the supervisor. Moreover, the roles of providing a fair hearing for ideas and providing administrative help generally did not distinguish the high and low innovation groups. Finally, members of the more innovative groups and their supervisors typically performed more roles for one another and fewer roles for outsiders and received less help from outsiders. An important exception to this overall pattern, however, was that the supervisors of the high innovation teams were "tuned in" to more outside sources of original ideas. These findings do not mean that the organizational context of a group is unimportant for its innovation; rather, they seem to suggest that excessive orientation to the outside can

be bad for a group's innovation, that an important role performed by outsiders is making original ideas available to a group through its supervisor, and that increased attention to sources of administrative help or a fair hearing for ideas will not pay off in increased group innovation.

The trends in the present research fit well with findings by Andrews and Farris (1967) that a supervisor's technical skills are consistently associated with his group's innovation. High technical skills are required for a supervisor to be useful to his group for critical evaluation or for him to recognize original ideas which come from the outside.

The associations between group innovation and the performance of colleague roles in the present study complements previous findings in studies of individuals by Farris (1971) and Swain (1971). Farris found that high past performance predicted that an individual scientist would be named more often as useful to his colleagues, and Swain(1971) and Farris (1971) found that higher performers were named more often as helpful to their colleagues. The trends in the present study suggest that the high performing individuals are especially helpful to other members of their scientific teams. In addition, Farris (1971) found that more innovative individual scientists named more colleagues as helpful to their problem solving for only two of the seven colleague roles: providing technical information and critical evaluation. The more innovative groups in the present study found particular colleagues as more helpful in these areas: fellow group members for providing technical information, and their supervisors for providing critical evaluation.

Another analysis in the present study related group innovation to the number of people with whom participants said they discussed technical matters once a week or more. This global communications question has

been used by Allen and his colleagues (e. g., Allen & Cohen, 1969) to study information flow in research and development laboratories. The same scores were constructed for this communications question as for the colleague roles. Except for a tendency for members of the high innovation teams to mention one another more often for frequent communication, these scores were unrelated to group innovation.³ This analysis supports the finding that members of the high innovation teams frequently name one another as useful for several colleague roles, but at the same time it emphasizes the importance of examining particular colleague roles in the problem-solving process. Examination of communications patterns alone would have obscured differences which occurred for particular colleague roles. In describing the problem-solving process associated with group innovation, it is important to know not only who talks to whom, but also who talks to whom about what.

Another trend in the present study is consistent with Allen's treatment of information flow in R & D as a two-step process. Supervisors of the high innovation teams named more outsiders as useful for one type of technical information: original ideas. It could be inferred that these supervisors serve as "technological gatekeepers" for these original ideas, passing them on to their teams as appropriate. Although the data indicate that the supervisors of the high innovation teams were not more apt to be gatekeepers for the role of locating technical information, some members of these teams may have been. Although members of high innovation teams did not name their supervisors often as useful

for providing technical information, they did name a greater percentage of their fellow team members for this role.

Practical implications

The trends in the present study point to the importance of teamwork in group innovation. Members of more innovative teams, including the supervisor, were more helpful to one another for several colleague roles. Much has been written about ways to encourage teamwork. Likert (1961, 1967) and Maier (1963) are good sources.

The trends suggest also that the supervisor himself need not be innovative in order to have an innovative team. In fact, the data suggest that when the supervisor is more useful for his original ideas, his team's innovation is lower.⁴ However, the supervisor should have the technical competence necessary for him to be able to recognize original ideas and provide critical evaluation. And he should have an interpersonal and cognitive style which allows him to help others to think through their problems and lets him provide critical evaluation in a manner which is constructive.

How may a team be made more innovative? The trends suggest that their supervisor may be a key man. He should encourage them to exchange technical information and help each other think through their technical problems, and he should be an active part of that process himself. He should seek original ideas from outside the group, but not impose his own ideas on them. Probably he should keep them abreast of developments in the organization so that they do not spend the energy necessary to go to a number of sources of such information themselves. If team members

are less helpful to one another, they may rely on colleagues outside the group for help in their technical problem solving. When they do, team innovation is lower.

If a team is already innovative, how may it be kept that way? Wells and Pelz (1966) offer several suggestions.

In closing, let us offer a word of caution to the manager. Group innovation is not the only characteristic to be desired in the output of the decision-making process in a scientific laboratory. Moreover, the teamwork which appears to be associated with group innovation may reach a level which in some situations is dysfunctional for the laboratory as a whole. Other aspects of scientific performance -- steady, productive work or work especially useful to the organization -- are important as well. Although the trends in this study show consistent patterns of colleague roles related to group innovation, different networks of colleague roles may turn out to be related to such other important aspects of scientific performance.

Footnotes

- (1) This research was supported by grant NGR23-005-395 from the National Aeronautics and Space Administration, Frank M. Andrews and George F. Farris, principal investigators.
- (2) Before relating colleague roles to innovation, two preliminary analyses were performed. In the first, the variance between groups was found to be greater than the variance within groups in innovation, suggesting that innovation is a quality associated with group membership. In the second, a comparison of the sizes of the high and low-innovation groups determined that group size was unrelated to group innovation.

The appropriate test of statistical significance to use with these data is subject to debate. The most conservative approach would be not to perform tests of significance, since these data do not represent a probability sample from a defined population, and since the purposes of this study are descriptive rather than inferential. A less conservative approach would be to report tests based on group averages, under the partially true assumption that an individual's scores are substantially associated with his team membership. The least conservative approach would be to report tests based on a comparison of individuals in the high and low innovation teams, under the partially true assumption that an individual's scores are substantially independent of his team membership. Unfortunately, there is no covariance analysis technique known to the author which is appropriate to use with these data to control for the association between an individual's score and his team membership.

In view of these issues, the data are reported on the basis of group averages, and tests of statistical significance are not shown. The criteria for reaching conclusions throughout this study were that a trend be clear and, where appropriate, reasonably consistent. Readers accustomed to looking for tests of statistical significance, however, can be assured that many of the trends would appear as "significant" if tested in conventional ways based on either of the less conservative assumptions. The general conclusions were not altered by the decision not to test "significance".

- (3) The scores were: (listed in the same order as in Table 1)
2.3, 2.1; .75, .64; 2.6, 2.9; .68, .74; .37, .26; and 1.0, 1.1.
- (4) Supervisors of the high innovation teams also scored lower on a test of creative ability than did the supervisors of the low innovation teams.

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Table 1. Colleague Roles in High and Low Innovation Groups at Each Stage of Decision Making.

	Suggestion Stage			Proposal Stage		Solution Stage	
	Orig Ideas	Tech Info	Org Info	Help Think	Crit Eval	Fair Hearing	Admin Help
For Supervisor by Outsiders							
High Innovation	2.3	3.4	2.3	2.1	3.0	1.9	3.1
Low Innovation	1.0	4.1	3.7	3.7	3.4	2.4	2.6
For Supervisor by Group							
High Innovation	.39	.36	0	.40	.21	0	.01
Low Innovation	.12	.05	0	.09	.05	0	0
For Outsiders by Supervisor							
High Innovation	1.0	2.0	1.3	1.3	.6	.6	.7
Low Innovation	1.9	2.4	1.3	2.3	1.0	.3	.1
For Group by Supervisor							
High Innovation	.32	.50	.55	.68	.79	.46	.64
Low Innovation	.44	.51	.62	.59	.45	.43	.53
For Group by Group							
High Innovation	.06	.14	.02	.11	.06	.02	.01
Low Innovation	.06	.09	.12	.07	.07	.03	.03
For Group by Outsiders							
High Innovation	.6	1.2	.8	1.0	.7	.4	1.0
Low Innovation	.6	1.2	1.0	1.2	.8	.6	1.0

Figure Captions

Figure 1

Some Factors in the Process of Executive Decision Making

Figure 2

Role Nets of Scientific Teams

Figure 3

Per Cent of Group Members who Mention
Their Supervisor for
Colleague Roles

Figure 4

Choices of Group Members by Other Group
Members for Colleague Roles.

Figure 5

Average Number of Outsiders Mentioned by
Group Members for Colleague Roles

Figure 6

Number of Times Supervisor Was Mentioned
by Outsiders for Colleague Roles

Figure Captions con.'t

Figure 7

Average Number of Outsiders Mentioned
by Supervisors for Colleague Roles.

Figure 8

Per Cent of Team Members Mentioned by
Their Supervisor for Colleague Roles.

Figure 1. Some Factors in the Process of
Executive Decision Making

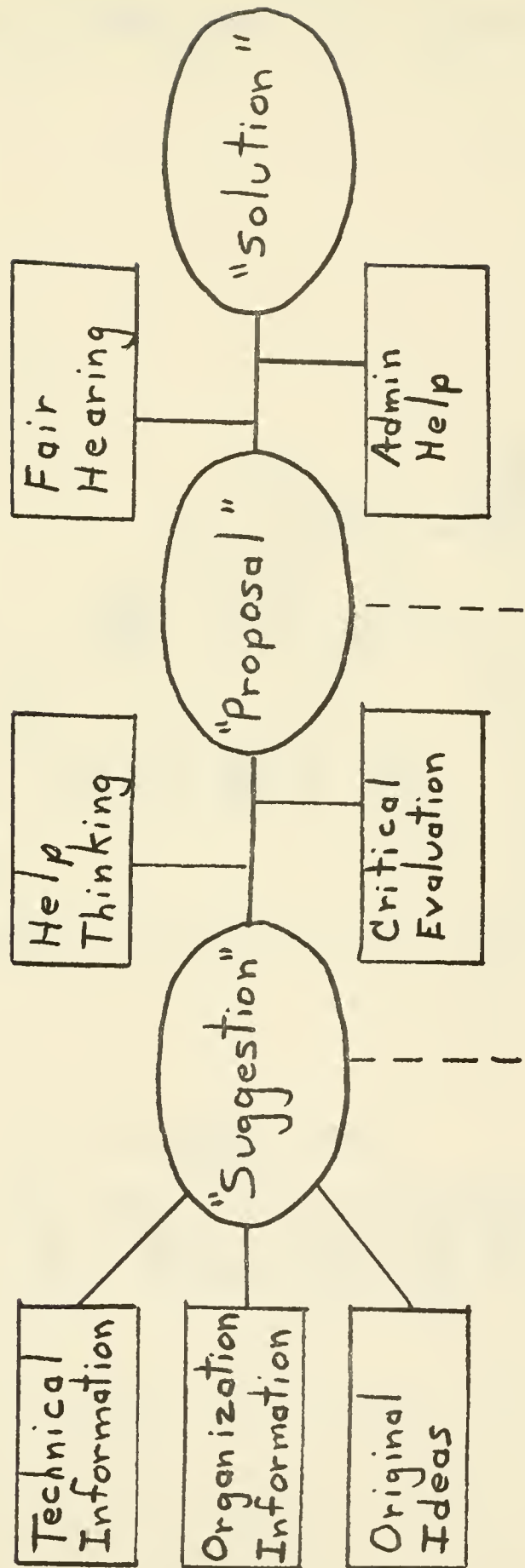
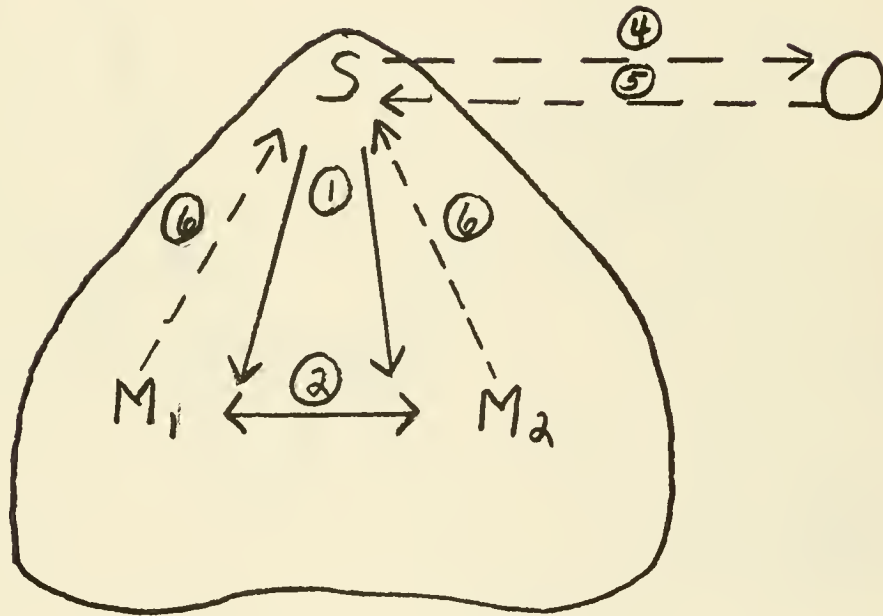


Figure 2. Role Nets of Scientific Teams



S = Supervisor

M_1, M_2 = Group Members

O = Person Outside the Group

Figure 3. Per cent of group members who mention their supervisor for colleague roles.

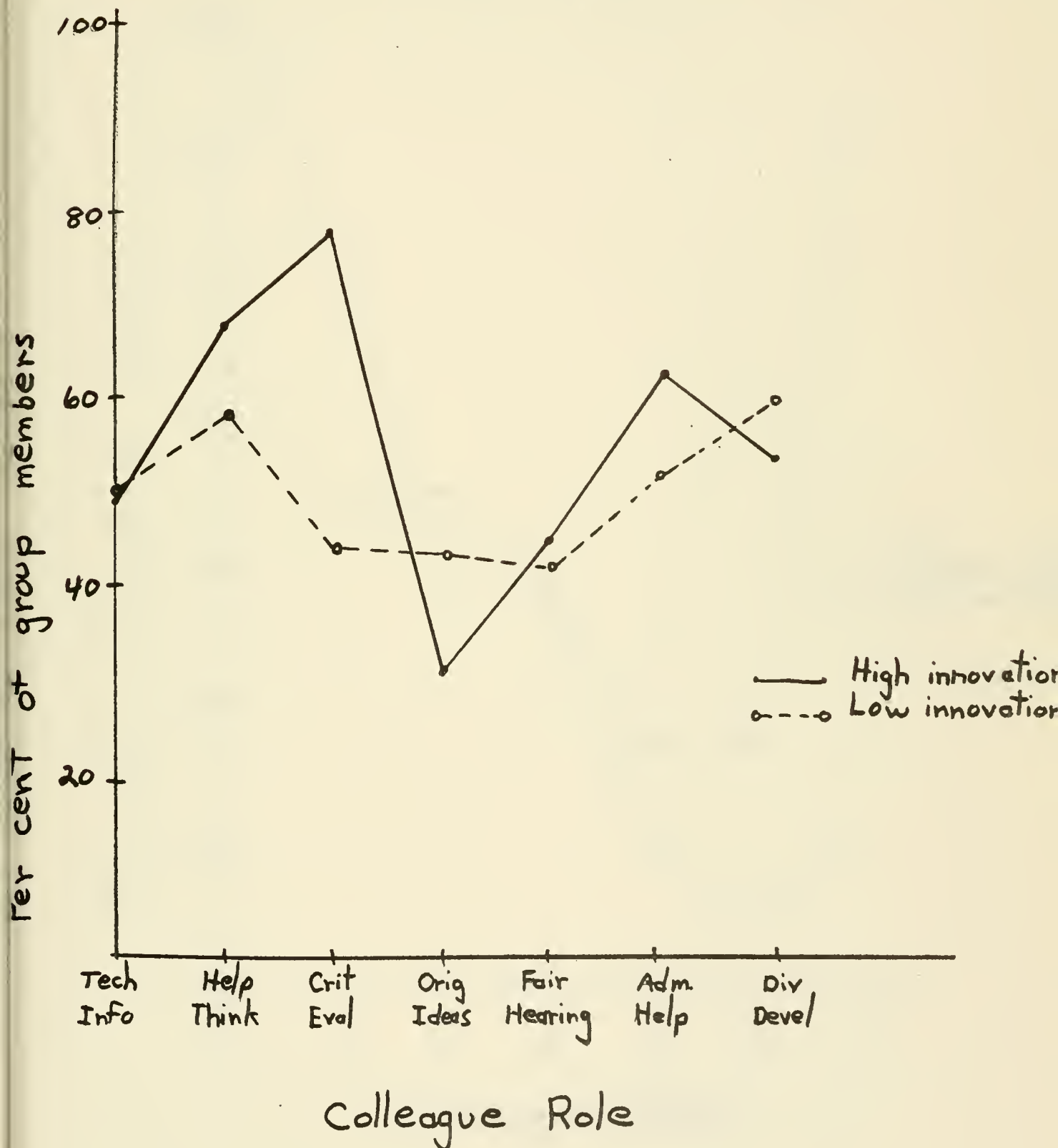


Figure 4. Choices of group members by other group members for colleague roles.

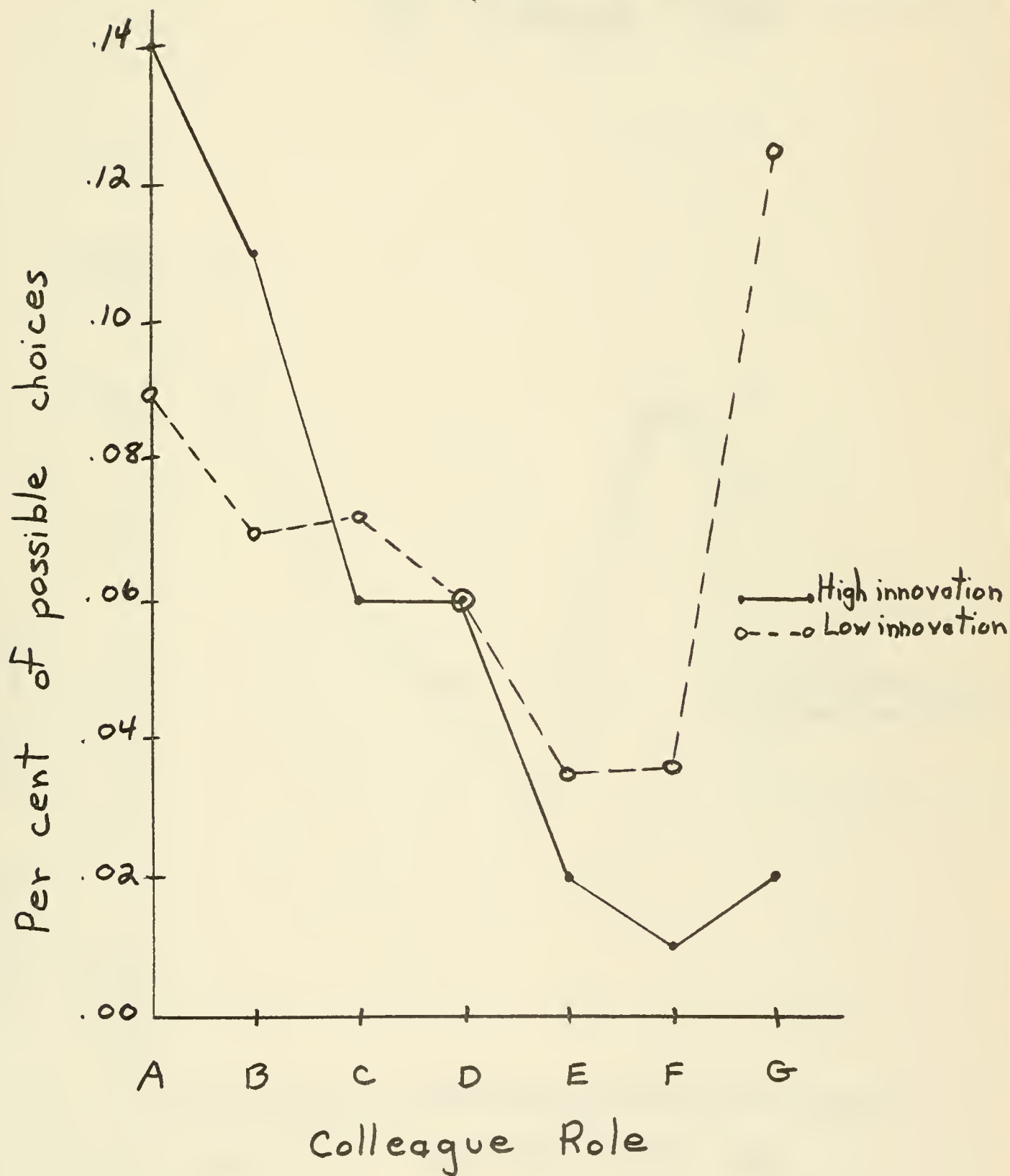


Figure 5. Average number of outsiders mentioned by group members for colleague roles.

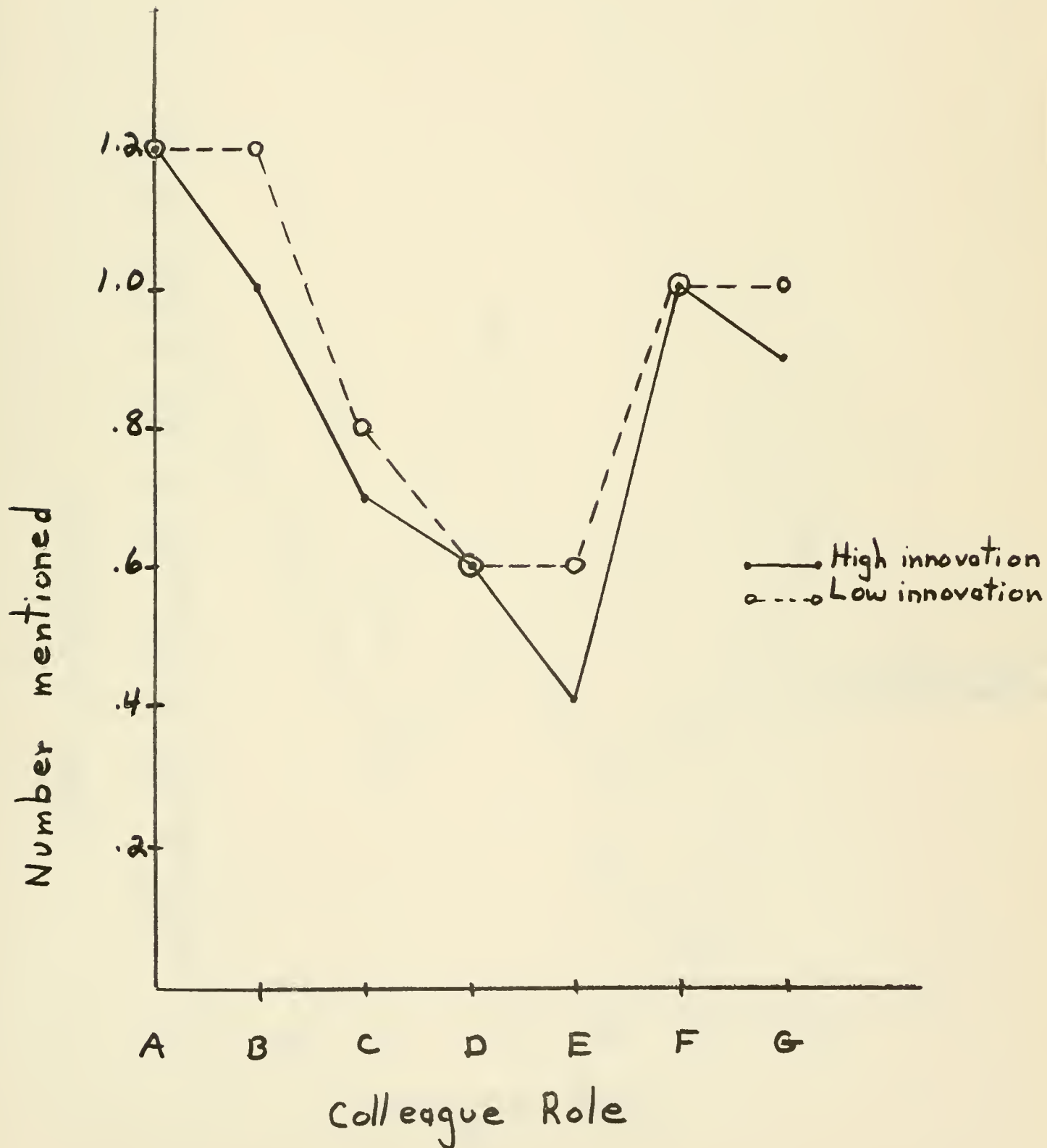


Figure 6. Number of times supervisor was mentioned by outsiders for colleague roles.

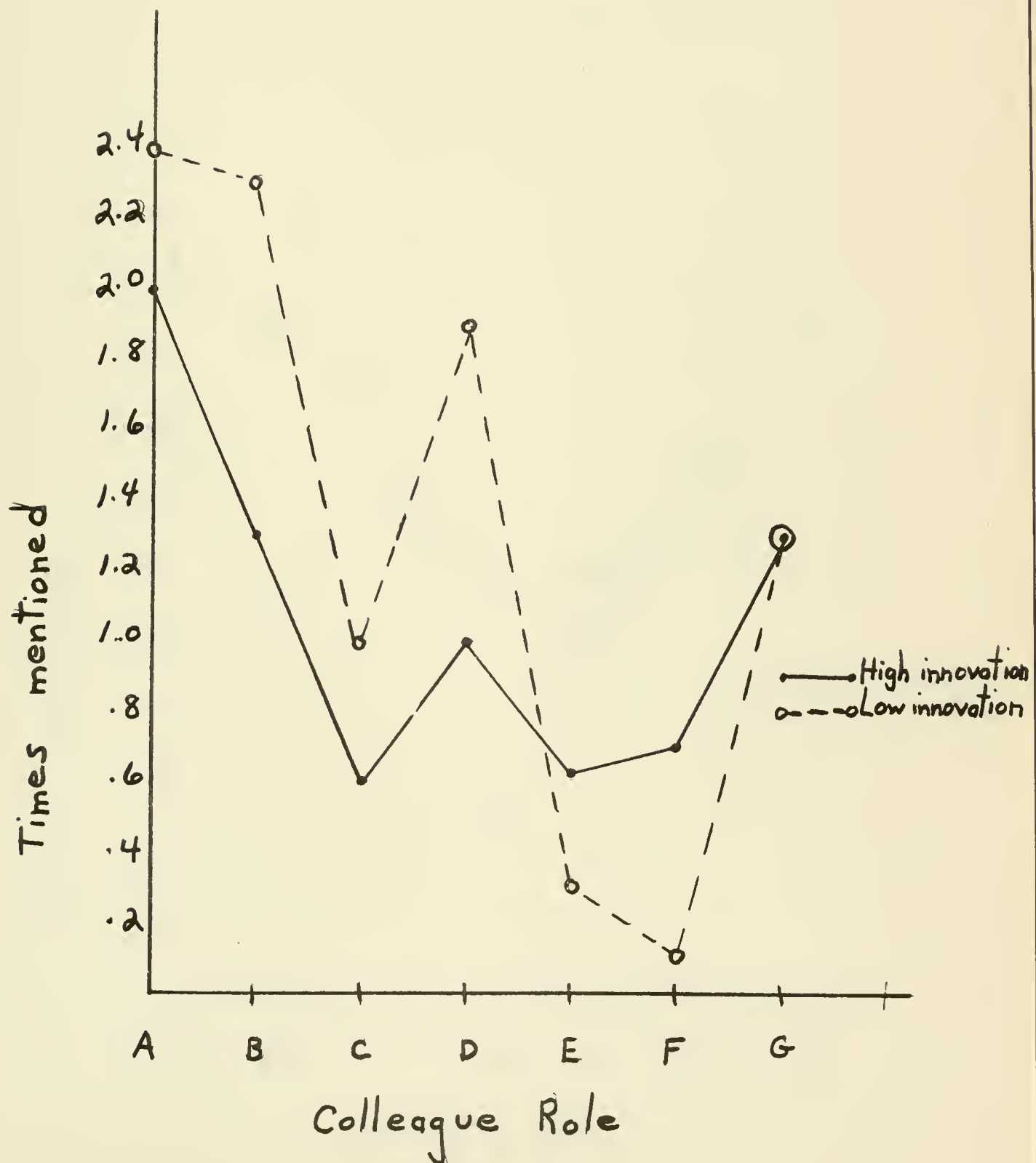


Figure 7. Average number of outsiders mentioned by supervisors for colleague roles.

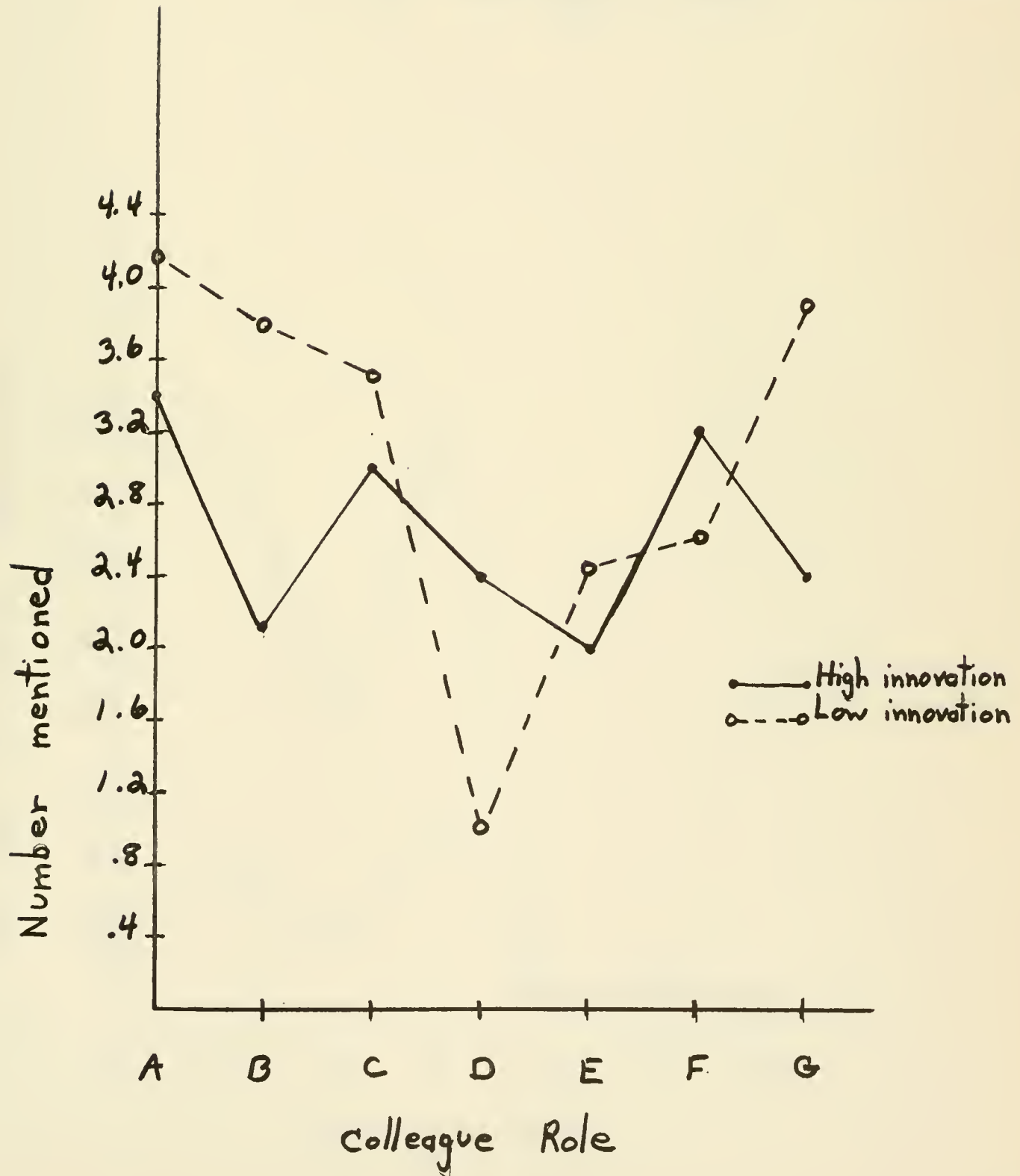
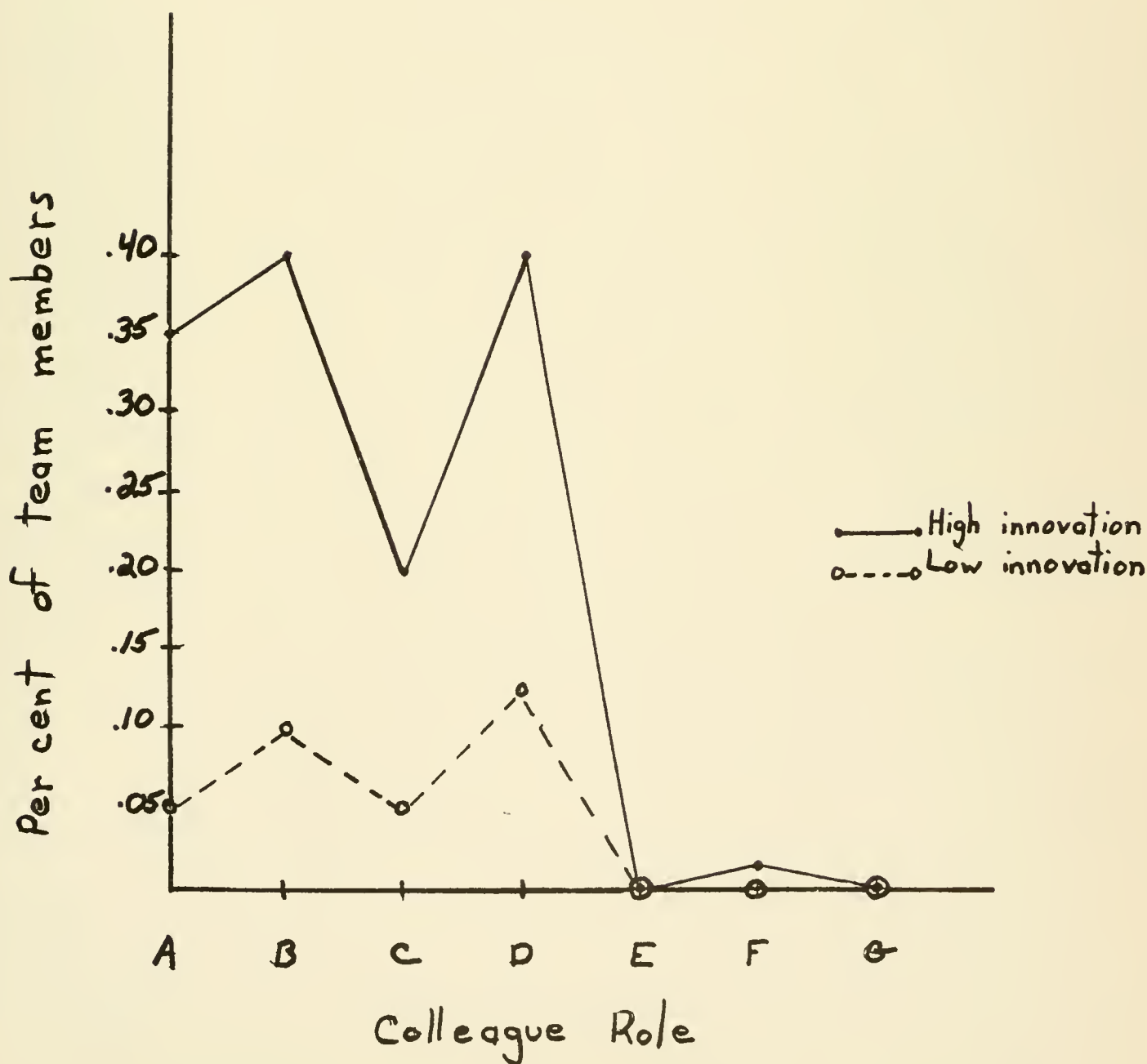


Figure 8. Per cent of team members mentioned by their supervisor for colleague roles.



no. 553-71 CANCELLED

BASIS

Date Due

DEC 05 '75

MAY 05 '77

MAR 10 '78

~~DEC 10 '78~~

~~DEC 8 '80~~

JUN 22 '81

JUN 14 '85

Lib-26-67



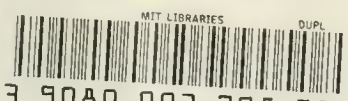
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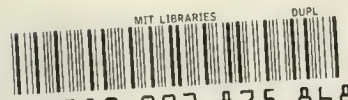
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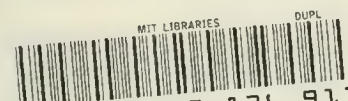
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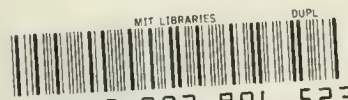
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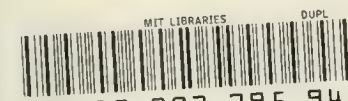
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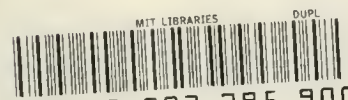
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